

Sediment Physical Properties Survey for the ONR GeoClutter Program

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LONG-TERM GOALS

The goals of this study are to (1) understand the physical basis for sonar backscatter patterns in shallow-marine environments and (2) develop new knowledge on the role of modern sedimentary processes in the morphodynamic evolution of the continental shelf seafloor.

OBJECTIVES

The central objective of this project is to determine the lateral and vertical variability of seafloor sediment porosity and bulk density using measurements of electrical resistivity made on sediment cores recovered at GeoClutter target sites. Specific tasks include the following: (1) conduct a coring survey to collect undisturbed samples of the sediment–water interface for field and laboratory analyses, (2) measure high-resolution profiles of sediment resistivity aboard ship, (3) compute porosities and saturated bulk densities for the cores based on the resistivity data and established empirical relationships, and (4) correlate porosity/density data with other sediment properties and high-frequency sonar backscatter signatures.

APPROACH

This study employs seafloor sampling and measurement techniques designed to maximize the integrity of sediment cores and physical-properties determinations. First, a hydraulically damped sediment corer capable of recovering undisturbed cores of sands and dense-clay deposits is used to recover representative seafloor deposits from GeoClutter study sites. This special instrument preserves the sediment–water interface and minimizes drainage of porewaters. Second, electrical resistivity measurements are made on cores in the field immediately upon collection to determine values of porosity and saturated bulk density (following analytical methods described in Andrews and Bennett, 1981 and Dowling, 1990). Together with sedimentological and geophysical studies performed by the Institute of Geophysics, University of Texas (UTIG), and *in-situ* P-wave velocity measurements performed by University of New Hampshire (UNH), the physical properties data will aid in characterization of GeoClutter hotspots and provide essential information for acoustic modeling performed by other research groups.

WORK COMPLETED

The primary tasks of this study have been completed. During a recent research on the New Jersey shelf (August 1–6, 2001), 98 sediment grabs and 25 slow cores were collected at sites representing the full range of sedimentary environments within the GeoClutter study area. All cores were logged for sediment resistivity in the field and were subsequently, split, described, photographed, and X-

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radiographed in the laboratory at the College of Marine Studies where they are presently in cold storage.

RESULTS

Preliminary results indicate that seabed-sediment porosities vary throughout the study area as a function of both sediment grain size and consolidation state, as predicted *a priori*. However, the variety of sediment types, fabric and consolidation states present within the upper 60 cm of the sediment column was not expected. Interestingly, seafloor deposits in the extreme southwestern and northwestern ends of the study area are composed of relict, over-consolidated marine clay mixed with transgressive sands, as well as minor gravel and shell. Primary depositional structures (e.g., bedding) is not preserved; at a number of sites sedimentary fabric is characterized by uniform shelf sands and erosional mud clasts (Figure 1). The transgressive sand sheet is thin to non-existent in some areas of the New Jersey shelf such that relict clay strata are exposed at the seafloor (e.g., Schurr–Duncan and Goff, 2001). Accordingly, seabed porosities are highly variable both along- and cross-shelf. The ubiquitous coarse sand and shell have important implications for the reworking of the clay strata, which are so dense as to be resistant to erosion by bottom flows alone. Based on preliminary observations it is apparent that corrosion, the scouring effects of a sediment load (akin to sand blasting), is contributing to the erosion of these strata.

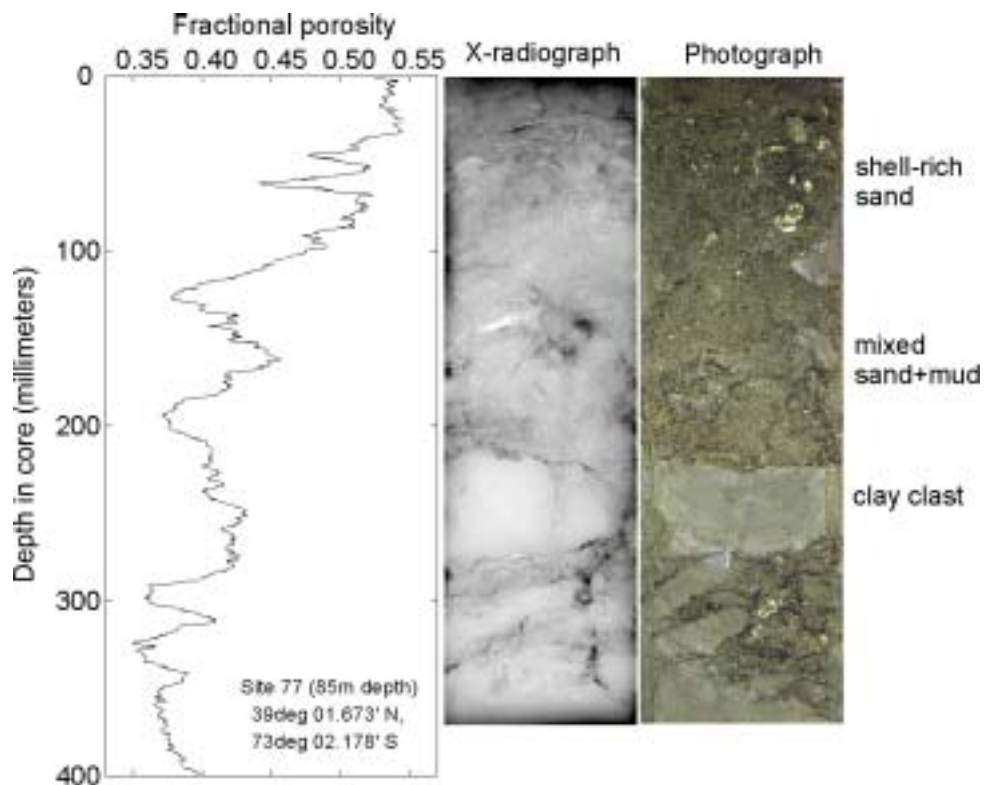


Figure 1. Example porosity profile, X-radiograph negative, and photograph of hydraulically damped core from the GeoClutter study site. A net downcore decrease in porosity is observed, as well as variability due to sediment grain size and consolidation state. Presence of mud clasts is indicative intense seafloor reworking at this depositional site.

IMPACT/APPLICATIONS

The goal of GeoClutter Phase II was to characterize seafloor geology at a number of pre-determined target sites by way of sediment coring and *in situ* physical property studies. The geological characterizations along with ocean acoustics experiments and modeling will be used to design signal-processing algorithms (by others) that distinguish natural features and man-made targets present at, and just below, the seafloor. In addition, new insights concerning the morphodynamic evolution of the New Jersey shelf have stemmed from this research (Austin et al., submitted).

TRANSITIONS

The results of this study are being used directly by GeoClutter investigators Drs. J. Goff (UTIG) and L. Mayer (UNH) to correlate seafloor physical properties, bottom roughness, and high frequency acoustic backscatter patterns. An improved basis for interpreting sonar backscatter data for geologically complex shelf environments is an expected outcome of this work. In addition, data generated through the present study will be made available to those STRATAFORM researchers investigating Pleistocene–Holocene strata formation and modification on the New Jersey shelf and elsewhere.

RELATED PROJECTS

Because the GeoGlutter site comprises part of the U.S. East Coast STRATAFORM study area, geological information generated by this study will benefit two separate ONR research initiatives. In addition to advancing an understanding of the geology responsible for sonar backscatter patterns, the new sedimentological data will shed light on creation of shelf ravinement surfaces, a fundamental aim of the STRATFORM Program.

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PUBLICATIONS

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